A Taxonomy for Platform Revenue Models: An Empirical-to-Conceptual Development Approach

Nedo Bartels[1] ✉[0000−0002−2540−6264], Matthias Koch[1][0000−0002−7640−5237], Anna Schmitt[1][0000−0002−5889−3708], and Jaap Gordijn[2,3][0000−0002−6401−3850]

[1] Fraunhofer IESE, Kaiserslautern, Germany, {nedo.bartels,matthias.koch,anna.schmitt}@iese.fraunhofer.de
[2] The Value Engineers, Soest, The Netherlands, jaap@thevalueengineers.nl
[3] Vrije Universiteit, Amsterdam, The Netherlands, j.gordijn@vu.nl

Abstract. In the field of Information Systems and Software Engineering, taxonomies are widely employed to organize and present well-designed knowledge. They play a crucial role in identifying relevant dimensions and characteristics associated with the objects under study. This paper focuses specifically on revenue models for platform business models, which facilitate the connection between providers and consumers in two-sided markets. For example, the Vinted Marketplace charges a transaction-based fee of 5% for each item sold, while nebenan.de offers platform access for a monthly subscription fee. Although these revenue model types differ, they both lead to distinctive and successful revenue models. Understanding and formalizing these revenue mechanisms is fundamental for the systematic design of revenue models for platform business models. This paper follows a proven taxonomy development method with two empirical-to-conceptual iteration cycles involving seven use cases. It introduces a comprehensive taxonomy comprising 15 dimensions and 79 characteristics. The proposed taxonomy contributes to the formalization of revenue models for platform business models and enhances the current understanding of the monetization strategies used by digital platforms to generate revenues. This paper supports researchers and practitioners involved in the design process of platform business models.

Keywords: Platform Business Model · Revenue Model · Taxonomy · Digital Platform

1 Introduction

The relevance of digital platforms is increasing continuously, and many companies have created new business models based on platforms, e.g., Uber Ride, Airbnb Lodging, Spotify Music, and eBay Marketplace. Companies are affected by this platform trend and need to make strategic decisions about how to position their business model to gain competitive advantages [19]. For example, Salesforce created AppExchange, a marketplace for B2B applications, as part of the redesign and expansion of their existing services. Defining a company's

business model is one way to describe the underlying logic of a business, and can be described based on three dimensions [23]: (1) What values, products, or services does a company offer for its customers (value delivery)? (2) How does a company create its values, products, or services (value creation)? (3) How does a company generates its revenue (value capture)? It is essential for a business to clarify these questions in order to define the company's strategy, how it aims to create value, and how it can capture value. Digital platforms are constantly emerging, and it is crucial for companies to pay attention to them in order to understand how platform business models can create and capture value. We argue that there is a lack of guidance for identifying suitable platform business models and designing effective revenue models to monetize digital platforms. To achieve this, we propose a taxonomy in this paper, which classifies dimensions and characteristics of revenue models specific to these platform businesses. Based on this, we derive the following research question: *What dimensions and characteristics can be used to describe revenue models of platform business models?*

To answer this research question, this paper follows a taxonomy development process using an empirical-to-conceptual approach according to Nickerson et al. [18]. Based on our previous taxonomy [7], we conducted two iteration cycles, analyzed seven platform business models, and extracted 26 revenue model types. The result of this study is a revised taxonomy comprising 15 dimensions and 79 characteristics for revenue models of platform business models and a classification of seven use cases. This paper is structured as follows: In Sec. 2, we introduce key terms and relevant related work. Sec. 3 presents the research design of the taxonomy development process, and Sec. 4 presents the findings, including the taxonomy we created in 4.1, the documented changes from both empirical-to-conceptual iteration cycles in 4.2, and the presentation of the analyzed platform revenue models in 4.3. Finally, Sec. 5 comprises our discussion, limitations, and future work.

2 Theoretical Background

A business model represents the underlying logic of a business, with a focus on how economic value is created, distributed, and consumed in a network of actors that are organizations [13]. In our case, we are looking at digital platforms and their business models, as they bundle several actors via a digital platform, and call this construct a platform business model. We advocate the logic that, e.g., the Uber Ride platform operator (asset broker) brokers rides (assets) provided by drivers (asset providers) for passengers (asset consumers) on its digital platform, as a software system that serves as the technical foundation, and is defined as a digital ecosystem according to [14]. In our understanding, a *platform business model* can be described with the following characteristics adapted from the definitions of [13][14][17][22]: (1) A platform business model describes the concept of how economic value is created, distributed, and consumed in a *network of parties*, called a digital ecosystem. (2) It creates value through *a digital platform*,

operated by a platform operator (i.e., asset broker), which connects at least *two market sides* – asset providers and asset consumers. (3) It *brokers assets* such as products or services via its digital platform. (4) A digital platform serves as the *hub of a digital ecosystem* consisting of companies working collaboratively and competitively to meet customer needs. The *revenue model* is part of the value capture dimension of a business model and clarifies which monetization mechanisms are used to capture value from the platform's mediation activities between its two-sided markets [6]. As each platform business model creates value differently, different revenue model types are needed to capture value. A revenue model should define appropriate revenue sources and revenue streams to capture the value delivered [22].

In this paper, we develop a taxonomy to classify dimensions and characteristics of revenue models for platform business models. A *taxonomy* is a form of classifying and grouping concepts or objects, whether derived from empirical evidence or conceptual frameworks. It provides researchers and practitioners with a means to analyze, structure, and comprehend complex domains [18]. Various taxonomies have been proposed in the literature to conceptualize digital platforms and their business models holistically. Van de Ven et al. [24] developed a *taxonomy for business models of data marketplaces*, which includes the five dimensions, 'revenue model', 'pricing model', 'price discovery', 'smart contract', and 'payment currency'. Springer and Petrik [20] proposed a *taxonomy for platform pricing in the context of the Industrial Internet of Things (IIoT)*, identifying 'pricing model', 'subsidization', and 'pie-splitting' as relevant impact factors for a revenue model. Staub et al. [21] presented a *taxonomy for digital platforms*, focusing on 'key revenue stream', 'price discovery', and 'price discrimination' as relevant dimensions for a revenue model. Freichel et al. [12] introduced a *taxonomy for digital platforms* categorized under 'technological perspective', 'economic perspective', and 'socio-cultural perspective'. Here, 'pricing mechanism' and 'primary revenue source' are specified. Täuscher and Laudien [22] proposed a *taxonomy for marketplace business models*, highlighting four dimensions for value capture, i.e., 'key revenue stream', 'pricing mechanism', 'price discrimination', and 'revenue source'.

While these existing taxonomies provide a comprehensive understanding of digital platforms and their business models, they do not specifically focus on revenue models for platform business models. The literature lacks a universal understanding, as authors mention similar dimensions (e.g., 'key revenue stream' used by Staub et al. [21] and Täuscher and Laudien [22]), while others introduce additional ones (e.g., 'payment currency' by Van de Ven et al. [24]). The lack of a taxonomy that reflects common dimensions and characteristics highlights a gap in the literature on formalizing revenue models of platform business models. Our research aims to address this gap by exploring and categorizing revenue model types for platform business models, thereby contributing to a better understanding of how digital platforms generate revenue. This knowledge can be used in the future to provide tool support, assisting practitioners in designing their own monetization strategies for platform business models.

3 Research Design

In the development of our taxonomy, we followed the guidelines proposed by Nickerson et al. [18]. These guidelines are widely recognized in the fields of Information Systems and Software Engineering, having proven their effectiveness in structuring existing knowledge about digital platforms and business models (as demonstrated, among others, in the taxonomy development of Staub et al. [21], Van de Ven et al. [24], or Weking et al. [25]). Although Kundisch et al. [16] have extended the approach of Nickerson et al. with their work on taxonomy evaluation, in this paper, we employed the taxonomy building methodology of Nickerson et al. [18]. Nonetheless, there is potential to enrich this research design by integrating the taxonomy evaluation methodology proposed by Kundisch et al. [16] in the future. The guidelines of Nickerson et al. [18] provide two approaches for developing a taxonomy: empirical-to-conceptual and conceptual-to-empirical. Building upon the initial taxonomy by Bartels et al. [7], which employed a conceptual-to-empirical approach, we present in this paper a revised version of the initial taxonomy. The initial taxonomy is depicted in Fig. 1. In

Revenue model			**Revenue model characteristics of a platform business model**							
Revenue model of the asset broker	DB1	Revenue model type of the asset broker	Access model	Commission model	Pay per use model	Sales model	Advertising model	Listing model	Donation model	Other
	DB2	Revenue stream of the asset broker	Access fees to platform	Commission fees on platform transactions	Commission fees on usage	Sales model of platform services	Advertising fees for space	Listing fees on platform	Donations	Other
	DB3	Revenue source of the asset broker	Asset consumers		Asset providers			Third party		Other
	DB4	Payment frequency of the platform price	One-time		Subscription-based frequency			Usage-based frequency		Other
	DB5	Price discovery of the platform price	Platform price set by asset providers		Platform price set by asset consumers		Platform price set by negotiation		Platform price set by asset broker	Other
	DB6	Price mechanism of the platform price	Fixed platform pricing				Variable platform pricing			Other
	DB7	Price discrimination of the platform price	Feature-based price discrimination		Quantity-based price discrimination			Location-based price discrimination		Other
Revenue model of the asset provider	DP1	Revenue model type of the asset provider	Sales model		Rental model			Pay per use model		Other
	DP2	Revenue stream of the asset provider	Sales of assets		Rental fees for assets			Usage fees for assets		Other
	DP3	Revenue source of the asset provider	Asset consumers		Asset broker			Third party		Other
	DP4	Payment frequency of the asset price	One-time		Subscription-based frequency			Usage-based frequency		Other
	DP5	Price discovery of the asset price	Asset price set by asset providers		Asset price set by asset consumers		Asset price set by negotiation		Asset price set by asset broker	Other
	DP6	Price mechanism of the asset price	Fixed asset pricing				Variable asset pricing			Other
	DP7	Price discrimination of the asset price	Feature-based price discrimination		Quantity-based price discrimination			Location-based price discrimination		Other

Fig. 1: Initial taxonomy of the first iteration [7]

this paper, we followed an empirical-to-conceptual approach in two iterations. The taxonomy development process, shown in Fig. 2, consists of three iteration cycles. In the first step of the taxonomy development process, the object of the taxonomy and its ending conditions were defined. The initial taxonomy (Fig. 1) as a result of *iteration 1* serves as the starting point for iterations 2 and 3. Iteration 1 is mentioned in Fig. 2 to provide a comprehensive overview of the research design. However, it is not discussed in detail in this paper. For more information on iteration 1, see Bartels et al. [7]. In *iteration 2*, we validated the practical relevance of the taxonomy by applying it to 19 revenue model types from five existing platforms mainly operated in Germany. This extended our analysis as we mapped the revenue models onto the initial taxonomy and revised it in a second version. The data presented in this paper is fully documented and available in [8]. In *iteration 3*, we further refined the taxonomy by applying it to seven revenue model types from two research projects until all ending conditions were met. In total, we applied the finalized taxonomy to 26 revenue model types.

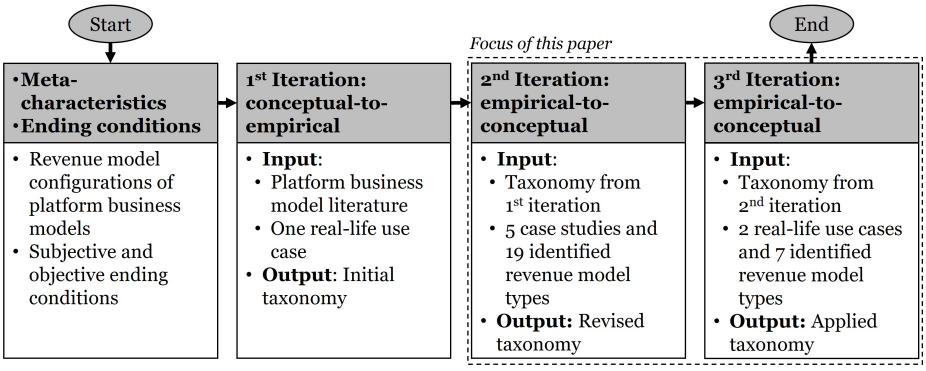

Fig. 2: Taxonomy development process adapted from Nickerson et al. [18]

3.1 Determination of meta-characteristics and ending conditions

We aim to create a taxonomy that includes the main dimensions and characteristics of revenue models of platform business model. For this, we defined our relevant revenue model configuration aspects as our *meta-characteristics*, like the revenue source and the revenue stream of a digital platform. To be accepted, the taxonomy must meet both objective and subjective *ending conditions* according to Nickerson et al. [18]: The taxonomy should (1) include the *main dimensions and characteristics* of revenue models for platform business models, and (2) not incorporate *new dimensions or characteristics* in the last iteration. Furthermore, the taxonomy must (3) strike a balance between being *meaningful and not being too complex or overwhelming*, and (4) also be *extensible* to accommodate new di-

mensions or characteristics. Lastly, (5) each dimension and characteristic should offer *explanatory* value about platform revenue models.

3.2 First iteration: conceptual development

The detailed description of iteration 1 can be found in the research data [8], and is outside the scope of this paper. A literature review on revenue models of platform business models was conducted using several databases, resulting in 930 papers. Out of these, 34 papers were deemed relevant and used to develop the taxonomy. Exclusion criteria were applied to the remaining 896 papers. A full-text review of the 34 included papers led to the identification of 68 dimensions and 258 characteristics for revenue models of platform business models. We synthesized the data by creating a concept matrix that summarizes the classifications for revenue models of platform business models in eight dimensions. To further develop and refine the extracted taxonomy of revenue models of platform business models, a UML class model was created. The aim of this model is to express the relationships between the relevant dimensions and their respective characteristics, and to specify the taxonomy derived from the literature review. Based on this, and to ensure applicability, the taxonomy was applied to a real-life use case from a research project. The resulting taxonomy is shown in Fig. 1.

3.3 Second iteration: empirical development

To address the empirical relevance of the taxonomy, we conducted a desk research between January and April 2023 to extract data. As a primary source of empirical cases on platform business models, we used the work of Koch et al. [15], which includes a list of 43 described platform business models. To select relevant platform business model cases, we assessed whether (1) two market sides, i.e., asset provider and asset consumer, could be identified; (2) sufficient information on the revenue model was available to understand the logic of value capture; and (3) the platform business model was not too complex and had no complex interdependencies with other related business models (see, for instance, Amazon Prime and its video, marketplace, and delivery connections). Through the analysis, we discovered that a complete revenue model for a platform business model cannot always be represented by a single revenue model type, but may involve combinations of several revenue model types. For example, the Vinted platform employs both a commission model for each transacted item and generates revenues through the sale of additional platform services, representing two distinct revenue model types. Consequently, we identified 19 revenue model types across five platforms: Tyre24, empto, MyHammer, Vinted, and nebenan.de, and applied the initial taxonomy to each one individually. Here, each revenue model type was mapped onto the taxonomy to assess whether it could be fully captured, and any missing dimensions or characteristics were documented in an Excel taxonomy grid. Each identified discrepancy or gap was then marked within the taxonomy and documented as a comment. Afterwards, all documented changes and comments were aggregated and, reviewed, and a

revised version of the taxonomy was created. The entire process of the second iteration is documented and can be found in the research data [9].

3.4 Third iteration: application in real-life use cases

In the third iteration, two research projects on digital platforms were used as case studies, and their revenue model descriptions were extracted from internal project documents. The revised taxonomy created after iteration 2 was used to identify and classify seven different revenue model types. The taxonomy was initially applied to one project, and any gaps were documented and addressed before it was used it on the second project. In the second research project, no gaps or changes were identified. The taxonomy had fulfilled all the necessary ending conditions in the second research project, meaning the taxonomy was finalized and the development process was stopped.

3.5 Selected use cases

For iteration 2 of our taxonomy development process five different platform business models were examined. We, started with Tyre24 [4] and then analyzed those of empto [1], MyHammer [2], Vinted [5], and nebenan.de [3]. To validate the completeness and correctness of the developed taxonomy in iteration 3, two research projects dealing with digital platforms were used as real-life use cases.

1) *Tyre24* is a digital platform for car parts trading. The Tyre24 platform is operated by the Saitow company (asset broker), which brokers car parts, such as tires (assets) provided by suppliers and distributors of car parts (asset providers), to car repair shops (asset customers).
2) *empto* is a digital platform for companies to manage their waste. The empto platform is operated by the Zentek Services company (asset broker), which brokers waste disposal services, such as disposal of glass waste (assets) provided by professional waste disposers (asset providers) to waste producing companies (asset customers).
3) *MyHammer* is a platform for finding local skilled trade businesses. The MyHammer platform is operated by the MyHammer company (asset broker), which brokers craft services, such as home repair and renovation services (assets) provided by local skilled trade businesses (asset providers) to homeowners (asset customers).
4) *Vinted* is a platform for buying and selling second-hand clothing and accessories. The Vinted platform is operated by the Vinted company (asset broker), which brokers clothing items, such as t-shirts (assets) provided by individual sellers (asset providers), to buyers (asset customers).
5) *nebenan.de* is a social network platform for local communities to connect and exchange goods and information. The nebenan.de platform is operated by the Good Hood company (asset broker), which brokers neighborhood-related information (assets) provided by local individuals, businesses, and organizations (asset providers) to neighbors (asset customers).

6) The first research project, called *Smarte.Land.Regionen* (SLR), was previously explored by Bartels and Schmitt [10] and aims to enhance public services in rural areas through digital solutions. In this paper, the developed taxonomy and the insights gained will be used to represent all types of revenue models of the SLR platform. The SLR platform is operated by the SLR platform operator (asset broker), which brokers digital solutions, such as mobility services (assets) provided by software companies (asset providers), to counties (asset customers) and their citizens.
7) The second research project, *Machine Sharing Platform* (MSP), focuses on improving the production process of small and medium-sized enterprises through a platform that allows the sharing of machine capacities between manufacturers. The digital platform is operated by the MSP operator (asset broker), which brokers machine capacities, such as CNC milling machines (assets), between companies that have unused capacities of their machine tools (asset providers), and companies that have production bottlenecks and need these capacities for their own production processes (asset consumers).

4 Findings

This paper presents several key findings. First, it presents a final version of the taxonomy that includes all changes. Second, it outlines the changes that were identified during the development process of the revised taxonomy for revenue models of platform business models. Third, the paper provides an overview of several use cases that were analyzed using the taxonomy.

4.1 Taxonomy for revenue models of platform business models

As discussed in the taxonomy building of Bartels et al. [7], we argue that a revenue model of a platform business model can only be described holistically if both the perspective of the asset broker as operator of the digital platform, and the perspective of the asset provider on the digital platform are reflected. Accordingly, the final taxonomy shown in Fig. 3 comprises 79 characteristics in 15 dimensions to take both perspectives into account. The taxonomy meets all ending conditions, and we claim that the taxonomy is complete.
A *revenue model type of the asset broker* (DB1) covers the revenue source and revenue stream through which the asset broker generates revenues. A *revenue stream of the asset broker* (DB2) describes how the asset broker generates revenues, i.e., the strategy the asset broker uses to monetize the revenue source through the platform. Access fees for platform participation, access fees for platform features, commission fees, a sales model of platform services, advertising fees for space, listing fees, or donations and sponsorships may be used to generate revenues. *The revenue source of the asset broker* (DB3) describes who is monetized by the asset broker, i.e., the actor through whom the asset broker generates the revenue stream. Here, asset consumers, asset providers, or third

parties can be monetized by the asset broker. The *payment trigger of the platform price* (DB4) describes when payments recur for the asset broker, i.e., the point at which the revenue source is charged by the broker. Pay per platform access, pay per platform service use, pay per asset transaction, pay per asset listing, pay per user-related contact data are points where payments can be triggered for the asset broker. Additionally, revenue sources can have the flexibility to choose when to pay (pay whenever they want). The *payment frequency of the platform price* (DB5) describes how often payments recur for the asset broker, i.e., the frequency with which the revenue source is charged by the asset broker. Payments can be made on a one-time basis or on a recurring basis. The *price discovery of the platform price* (DB6) describes who sets the platform price, i.e., whether the platform price is set by the asset broker, by asset providers, asset consumers, or by negotiations. The *price mechanism of the platform price* (DB7)

Revenue model			**Revenue model characteristics of a platform business model**							
Revenue model of the asset broker	DB1	Revenue model type of the asset broker	Access model		Listing model	Advertising model	Commission model	Sales model	Donation and Sponsorship model	Other
	DB2	Revenue stream of the asset broker	Access fees for platform participation	Access fees for platform features	Listing fees on platform	Advertising fees for space	Commission fees	Sales model of platform services	Donations or sponsorships	Other
	DB3	Revenue source of the asset broker	Asset consumers		Asset providers			Third party		Other
	DB4	Payment trigger of the platform price	Pay per platform access		Pay per asset listing	Pay per user-related contact data	Pay per asset transaction	Pay per platform service use	Pay whenever you want	Other
	DB5	Payment frequency of the platform price	Pay once			Pay on a recurring basis				Other
	DB6	Price discovery of the platform price	Platform price set by asset broker		Platform price set by asset providers		Platform price set by asset consumers		Platform price set by negotiation	Other
	DB7	Price mechanism of the platform price	Absolute value		Percentage value		Variable (negotiated) value		Pay what you want	Other
	DB8	Price discrimination of the platform price	Type of asset	Type of user	Quantity of asset	Location of user	Different platform tariffs		No price discrimination	Other
Revenue model of the asset provider	DP1	Revenue model type of the asset provider	Sales model		Rental model		Pay per use model		Donation and sponsorship model	Other
	DP2	Revenue stream of the asset provider	Sales of assets		Rental fees for assets		Usage fees for assets		Donations or sponsorships	Other
	DP3	Revenue source of the asset provider	Asset consumers		Asset broker			Third party		Other
	DP4	Payment frequency of the asset price	Pay per asset subscription	Pay per asset use	Pay per rent		Pay once		Pay whenever you want	Other
	DP5	Price discovery of the asset price	Platform price set by asset broker		Platform price set by asset providers		Platform price set by asset consumers		Platform price set by negotiation	Other
	DP6	Price mechanism of the asset price	Fixed asset pricing				Variable asset pricing			Other
	DP7	Price discrimination of the asset price	Quantity of asset		Location of user		Type of user		No price discrimination	Other

Fig. 3: Revised taxonomy after the third iteration

describes the influence of supply and demand on the platform price, i.e., whether the platform price is fixed or variable. The price of a platform can be fixed as either an absolute or percentage value, or it can be variable and negotiated, or have no constraints (pay what you want). If *price discrimination of the platform price* (DB8) exists, it can be described by different platform prices that are influenced by discriminatory factors, i.e., whether such factors affect the price to be paid on the platform. Platform price discrimination can take various forms, such as differentiating based on user type, user location, asset type, asset quantity, or through different platform tariffs, such as basic, pro, or premium tariffs.

A *revenue model type of the asset provider* (DP1) covers the revenue source and revenue stream by which the asset providers generate revenues. The *revenue stream of the asset provider* (DP2) describes how the asset providers generate revenues, i.e., the strategy the asset providers use to monetize the revenue source through the platform. The asset provider can generate revenue through the platform by selling, renting, charging a usage-based fee for the asset, or receiving donations and sponsorships. The *revenue source of the asset provider* (DP3) describes who is monetized by the asset providers, i.e., the actor through which asset providers generate their revenue stream. Asset consumers, the asset broker, or third parties can generate revenue for the asset providers. The *payment frequency of the asset price* (DP4) describes how often payments recur for asset providers, i.e., the frequency with which the revenue source is charged by the asset providers. Payments for an asset can be made either as a one-time payment at the time of asset purchase, with each asset subscription, with each use of the asset, or with each rental of the asset. Alternatively, payments can be left to the discretion of the revenue source via the pay whenever you want option. The *price discovery of the asset price* (DP5) describes who sets asset prices on the platform, i.e., whether asset prices are set by the asset broker, by asset providers, by asset consumers, or by negotiations. The *price mechanism of the asset price* (DP6) describes the influence of supply and demand on asset prices, i.e., whether asset prices on the platform are fixed or variable. The price of an asset can be a fixed and listed price, or it can be variable price and dependent on the current demand. If *price discrimination of asset prices* (DP7) exists, it can be described in terms of different asset prices that are influenced by discriminatory factors on the platform. Asset price discrimination can take the form of asset quantity, user location, or user type.

4.2 Findings from the empirical-to-conceptual taxonomy development process

The revisions made to the taxonomy in Fig. 1, are reflected in Table 1 with 34 total changes, based on two empirical-to-conceptual iterations. Table 1 provides a categorized documentation of all changes made, including a change number (N°), and the iteration in which the change occurred (2nd or 3rd iteration). Additionally, it identifies the platform business model that prompted the change, such as Tyre24.

Table 1: Documented changes of the taxonomy development process

N°	Iter.	Causer	At	Type	Impact	Change
1	2nd	Tyre24	DB1	Duplicate	Moderate	'Pay-per-use model' is replaced by 'pay per' in DB4
2	2nd	nebenan	DB1	Extend	Moderate	'Donation model' is extended to 'donation and sponsorship model'
3	2nd	Tyre24	DB2	Split	Moderate	'Access fees' is split into 'participation in a platform' and 'access to platform services'
4	2nd	Tyre24	DB2	Merge	Moderate	'Commission fees on platform transactions' and 'commission fees on usage' is merged into 'commission fees'
5	2nd	nebenan	DB2	Extend	Moderate	'Donations' is extended to 'donations and sponsorships'
6	2nd	n/a	DB4	Replace	Minor	'One-time' is replaced by 'pay once'
7	2nd	Tyre24	DB4	Replace	Minor	'Subscription-based frequency' is replaced by 'pay on a recurring basis'
8	2nd	My Hammer	DB4	Split	Moderate	'Usage-based frequency' is split into 'pay per platform access', 'pay per asset listing', 'pay per user-related contact data', 'pay per asset transaction' and 'pay per platform service use'
9	2nd	empto	DB6	Split	Moderate	'Fixed platform pricing' is split into 'absolute value' and 'percentage value'
10	2nd	Vinted	DB6	Replace	Minor	'Variable platform prices' is replaced by 'variable (negotiated) value'
11	2nd	My Hammer	DB7	Split	Moderate	'Feature-based price discrimination' is split into 'type of asset', 'type of user', 'location of user' and 'different platform tariffs'
12	2nd	Vinted	DB7	Replace	Minor	'Quantity-based price discrimination' is replaced by 'quantity of asset'
13	2nd	n/a	DB7	Replace	Minor	'Location-based price discrimination' is replaced by 'location of user'
14	2nd	empto	DB7	Extend	Moderate	'No price discrimination' is added
15	2nd	nebenan	DP1	Extend	Moderate	'Donation and sponsorship model' is added
16	2nd	nebenan	DP2	Extend	Moderate	'Donations and sponsorships' is added
17	2nd	n/a	DP4	Replace	Minor	'Subscription-based frequency' is replaced by 'pay per asset subscription'
18	2nd	n/a	DP4	Split	Moderate	'Usage-based frequency' is split into 'pay per asset use', 'pay per rent' and 'pay once'
19	2nd	nebenan	DP4	Extend	Moderate	'Pay whenever you want' is added
20	2nd	Vinted	DP7	Replace	Minor	'Feature-based price discrimination' is replaced by 'type of user'
21	2nd	n/a	DP7	Replace	Minor	'Quantity-based price discrimination' is replaced by 'quantity of asset'
22	2nd	n/a	DP7	Replace	Minor	'Location-based price discrimination' is replaced by 'location of user'
23	2nd	Tyre24	DB7	Extend	Moderate	'No price discrimination' is added
24	3rd	SLR	n/a	Extend	Major	New dimension 'payment trigger' is added
25	3rd	SLR	DB4	Replace	Moderate	'Pay per platform subscription' is replaced by 'pay per platform access' and is added to new dimension in N° 24
26	3rd	SLR	DB4	Replace	Moderate	'Pay per platform service use' is added to new dimension in N° 24
27	3rd	SLR	DB4	Replace	Moderate	'Pay per asset transaction' is added to new dimension in N° 24
28	3rd	SLR	DB4	Replace	Moderate	'Pay per asset listing' is added to new dimension in N° 24
29	3rd	SLR	DB4	Replace	Moderate	'Pay per user-related contact data' is added to new dimension in N° 24
30	3rd	SLR	DB4	Replace	Moderate	'Pay what you want' is replaced by 'pay whenever you want' and is added to new dimension in N° 24
31	3rd	SLR	DB4	Extend	Moderate	'Other' is added
32	3rd	SLR	DB4	Replace	Minor	Description of 'pay once' is replaced
33	3rd	SLR	DB4	Replace	Minor	'Pay per platform subscription' is replaced by 'Pay on a recurring basis'
34	3rd	SLR	DB7	Extend	Minor	'Pay what you want' is added

The dimension where the change occurred is noted, ranging from DB1 to DP7.

The specific type of modification, whether it is a duplication or an extension, is stated as well. The table further categorizes the level of impact each change had on the taxonomy, classifying it as minor, moderate, or major. Finally, a description of each change is provided to give more context and details. Changes that were not triggered by a specific platform as causer but emerged during the taxonomy development process are marked as not applicable (n/a). As outlined in Sec. 3, two empirical-to-conceptual iterations were carried out that led to a holistic improvement of the taxonomy. In the third iteration, when we applied the taxonomy to real-life use cases, we assumed that there would be no more significant changes. However, we identified a completely new dimension, 'payment trigger', which was of great value, but surprisingly occurred surprisingly at a late stage in the development process.

The development process was considered complete as no further changes were identified in the application of the Machine Sharing Platform as the second use case during the third iteration, resulting in a stable state of the taxonomy. The types of changes were classified into five categories: duplicate, extend, split, merge, and replace, with descriptions provided for each. Of the 34 changes made, 68% were identified in the first iteration of the empirical-to-conceptual development phase. However, the SLR platform observed in the last iteration caused the most changes to the taxonomy, accounting for 32% of all changes. This is because a new dimension, 'payment trigger', was identified. The revenue model of the SLR platform employs a listing model, where each digital solution listed on the platform incurs a one-time fee and a recurring fee for the asset provider. Therefore, the payment trigger 'pay per asset listing' should be distinguished from the payment frequency dimension and its characteristics 'pay once' or 'pay on a recurring basis', as combining them as one dimension would not differentiate the listing model of the SLR platform sufficiently. This change had a significant impact on the taxonomy. Other dimensions, such as 'revenue source' (DB3) and 'price discovery' (DB6), were not changed during the iterations. Among the types of changes, 'replace' (50%) and 'extend' (29%) were the most frequent. The majority of changes had a moderate impact on the taxonomy, with nearly 62% involving only name or description changes to individual characteristics. In summary, the two empirical-to-conceptual iterations led to a more comprehensive and robust taxonomy than the initial version in Fig. 1. For a more detailed documentation of the changes made over each iteration, see [9].

4.3 Presentation of the analyzed platform revenue models

The taxonomy analysis and examination of the revenue models of the seven platform business models led to the identification of 26 distinct revenue model types for the asset brokers, which are presented in Table 2. For each platform business model the summary is based on three aggregated dimensions: (1) *Who is monetized?*, (2) *how is it monetized?*, and (3) *how much is monetized?*. As shown in Table 2, the number of revenue model types varies among the seven platform business models. The Vinted platform has the largest number of revenue model

types with six, followed by Tyre24 and nebenan.de with five each. On the other hand, the MyHammer platform monetizes its entire platform business model with a single commission model and shows the variety in revenue model types. Overall, it can be said that about 46% of the 26 examined revenue model types use asset consumers as their revenue source, 42% use asset providers, and only 12% use third parties. The most common revenue streams are access models with 35% and commission models with 27%. The analysis of the revenue models of the asset providers showed that they often rely on selling their own assets, with sales models representing 75% of their revenue streams on the platform. 88% of the revenue sources for asset providers are from asset consumers and 13% from asset brokers. Further information is available in the research data [9]. Tyre24 offers basic and premium access models for platform participation at €29 and €69 per month, each with different features. The platform generates revenue by monetizing car repair shops as asset consumers who buy car parts and accessories. Commission models apply, with 3.9% for basic access and 1.9% for premium access.

Table 2: Analyzed revenue model types for each platform business model

N°	Platform	Who pays?	How is it monetized?	How much is monetized?
1	***Tyre24***	Consumers	Access fees to participate	€29 or €69 monthly
2	***Tyre24***	Consumers	Commission fees	3.9% or 1.9% per transaction
3	***Tyre24***	Consumers	Access fees to service	Free or €99 monthly
4	***Tyre24***	Providers	Access fees to service	Free or €99 monthly
5	***Tyre24***	Providers	Commission fees	Free or 0.9% per transaction
6	***empto***	Consumers	Commission fees	4% per transaction
7	***empto***	Consumers	Commission fees	4% per transaction
8	***My Hammer***	Providers	Commission fees	€1-€89 per user contact
9	***Vinted***	Consumers	Commission fees	5% per transaction
10	***Vinted***	Consumers	Protection service	€0.7 per transaction
11	***Vinted***	Consumers	Verification service	€25 per item
12	***Vinted***	Providers	Item visibility service	On demand
13	***Vinted***	Providers	Best matches service	€6.95 per item per week
14	***Vinted***	Third party	Fees for advertising space	On demand
15	***nebenan***	Consumers	Donations for platform	Pay what you want
16	***nebenan***	Providers (business)	Access fees to participate	€12, €19, or €49 monthly
17	***nebenan***	Providers (organizations)	Access fees to participate	€10, €18, or €50 monthly
18	***nebenan***	Third party	Sponsorship with platform	On demand
19	***nebenan***	Third party	Fees for advertising space	On demand
20	***SLR***	Consumers	Access fees to participate	€500 one-time
21	***SLR***	Consumers	Access fees to participate	€140 monthly
22	***SLR***	Providers	Listing fees for asset	€1.000 one-time
23	***SLR***	Providers	Listing fees for asset	€250 monthly
24	***MSP***	Consumers	Access fees to participate	€5250 one-time
25	***MSP***	Providers	Access fees to participate	€5250 one-time
26	***MSP***	Providers	Commission fees	23% per transaction

Suppliers of car repair items are also monetized, with transaction fees of 0.9% depending on their commission group. The revenue model for asset providers is based solely on sales of their car parts on the platform. The empto platform charges a 4% commission fee per transaction for both waste producing companies and waste disposers. The platform's revenue model for asset providers is solely based on sales of their disposal services on the platform, without any additional

revenue streams. The revenue model of the MyHammer platform is based on a commission model, where skilled trade businesses that act as asset providers are charged a fee for each confirmed contact with a householder. Commission fees vary based on the type and scope of the trade service, ranging from €1 to €89 per contact confirmation. The revenue model for asset providers is solely based on sales of their trade services on the platform, without any additional revenue streams. Vinted generates revenue through a commission model and platform service fees for buyer protection and item verification. The platform charges buyers a 5% commission fee per transaction, a mandatory €0.70 fee for buyer protection, and an optional item verification service fee is €25 per item. Sellers can purchase 'bumps' to increase the visibility of their clothing items. Third parties are monetized through an advertisement model on the platform. The revenue model for asset providers is based solely on sales of their clothing items. nebenan.de charges local businesses and non-profit organizations an access fee ranging from €10 to €50 per month for publishing posts. nebenan.de generates revenue through donations, voluntary contributions, and partnerships with cities and municipalities. Local organizations can earn donations, while the platform increases the visibility of local shop products without selling directly. The SLR platform generates revenue through an access model and a listing model. Counties pay a one-time fee of €500 and a monthly fee of €140 to participate in the platform, while software companies pay a one-time fee of €1.000 and a monthly fee of €250 for each solution listed on the SLR platform. The revenue model for asset providers is based solely on sales of their digital solutions. The Machine Sharing Platform charges a one-time participation fee of €5250 for companies to access the platform and monetizes asset providers through a 23% commission on each transaction. The revenue model for asset providers is based solely on sales of their machine capacities on the platform.

5 Discussion and Conclusion

This study provides three main contributions: (1) a detailed and extensive taxonomy of revenue models of platform business models; (2) evidence that platform business models can adopt various revenue model types that can be creatively combined to develop innovative monetizing strategies; and (3) an analysis of seven platform business models resulting in the identification of 26 distinct revenue model types. The research question of how to classify revenue models of platform business models is answered with the applied taxonomy, which comprises 15 dimensions and 79 characteristics. We consider the use of the empirical-to-conceptual iteration cycles in this research successful, as we found 34 changes from the initial taxonomy and created a revised taxonomy. 68% of all changes were found in the first iteration cycle, while 32% were found in the second. Five dimensions with their associated characteristics were not changed, whereas the remaining ten dimensions underwent changes ranging from minor character changes to major dimensional adjustments. Based on the data we analyzed [9], we found that the most common revenue model types of the 26 revenue model types

we analyzed fall into the category of access model (35%) and commission model (27%). The cluster analysis conducted by Täuscher and Laudien [22] shows that 72% of the 100 examined marketplaces generate revenue through commission fees. The authors applied their taxonomy to each platform business model once. In contrast, we applied our taxonomy multiple times for each platform business model, as we identified various revenue model types for a single platform (e.g. Tyre24). Five of the seven platform business models we examined (71%) operate a commission model (Tyre24, empto, MyHammer, Vinted, and MSP), which aligns with the finding of Täuscher and Laudien (72%). However, when analyzing all 26 identified revenue model types across the seven examined platform business models, it becomes apparent that commission models account for only 27% of the total. This observation suggests that platforms such as Tyre24 employ multiple revenue model types simultaneously. This leads to the conclusion that platform revenue models often involve a combination of revenue model types. As a result, describing platform revenue models using a single revenue model type may not accurately capture the diverse approaches used to generate revenues.

Limitations. We made an effort to ensure that the development of the presented taxonomy was as transparent as possible and are documented in the research data. However, there are limitations to our study that need to be addressed. The use cases we selected represent only a small portion of existing platform business models, and are focused on platforms that are mainly operated in Germany, so that the results may have regional constraints. Other or additional use cases may lead to changes in the taxonomy that were not captured in this paper. Although the taxonomy was developed with great care through both conceptual-to-empirical and empirical-to-conceptual iteration cycles and claims to be complete, we cannot guarantee this. It is important to note that the taxonomy is only stable until further iterations reveal new potential dimensions and characteristics. We expect the taxonomy to be stable, as no further changes were identified during the last case study.

Future work on the proposed taxonomy should explore various revenue models of platform businesses in real-world settings to evaluate the validity of the proposed taxonomy. The updated taxonomy guidance proposed by Kundisch et al. [16], extends the approach of Nickerson et al. [18], providing taxonomy designers with a method to evaluate their developed taxonomies. Based on this, our next step is to integrate our taxonomy into the business model design process and assess its applicability in supporting practitioners define appropriate platform revenue models. The goal of this research is to make the taxonomy available as a design tool for practitioners to systematically create revenue models, as suggested by Bartels and Gordijn [6]. We also aim to understand the dynamic changes in platform business models, from the initial phase of a platform with a small user base to a stage with a critical mass of asset providers and consumers, potentially enabling reinforcing network effects. We posit that different development stages of a platform could influence the design choices of a platform op-

erator regarding an appropriate revenue model. Such a model must incentivize providers and consumers (for example, through sign-up discounts) while also capturing value through monetization mechanisms. Furthermore, future studies should also explore the correlation of different types of revenue models for specific platform business models. For instance, a donation-based revenue model, like the one implemented by nebenan.de, may have different enablers or barriers compared to a transaction-based revenue model, such as the one employed by the empto platform. We believe this complex business model dynamics and evolvement requires further exploration. A well-constructed taxonomy can contribute to theory building by representing forms of descriptive knowledge [18]. In this regard, our taxonomy can serve as an instrument for extracting unidentified knowledge about platform revenue model strategies. This newfound knowledge could be ensured in the form of platform revenue model archetypes, similar to the approach taken by Bergman et al. [11] in extracting business model archetypes for data marketplaces within the automotive industry. Our aim is to identify platform revenue model archetypes as design patterns that reflect proven design knowledge. Therefore, we want to create a design tool that can be used by practitioners in various settings such as interactive workshops, thereby enhancing the accessibility and practicality of this knowledge.

Acknowledgments We thank Sonnhild Namingha for linguistic revision. The research was conducted as part of the Smarte.Land.Regionen project (2818SL001).

References

1. Homepage of empto. `https://www.empto.de/`, accessed: 2023-04-30
2. Homepage of myhammer. `https://www.my-hammer.de/`, accessed: 2023-04-30
3. Homepage of nebenan.de. `https://nebenan.de/`, accessed: 2023-04-30
4. Homepage of tyre24. `https://tyre24.alzura.com/`, accessed: 2023-04-30
5. Homepage of vinted. `https://www.vinted.de/`, accessed: 2023-04-30
6. Bartels, N., Gordijn, J.: A business model construction kit for platform business models - research preview. In: Requirements Engineering: Foundation for Software Quality, pp. 175–182. Springer International Publishing (2022). https://doi.org/10.1007/978-3-030-98464-9˙14
7. Bartels, N., Koch, M., Gordijn, J.: Developing a taxonomy for revenue models of platform business models. In: 36th Bled eConference Digital Economy and Society - the Balancing Act for Digital Innovation in Times of Instability: Conference Proceedings. University of Maribor Press (2023)
8. Bartels, N., Koch, M., Gordijn, J.: Reserach data taxonomy for revenue models of platform business models. Zenodo (2023), `https://doi.org/10.5281/zenodo.7635726`
9. Bartels, N., Koch, M., Schmitt, A., Gordijn, J.: Reserach data taxonomy for platform revenue models. Zenodo (2023), `https://doi.org/10.5281/zenodo.7965631`
10. Bartels, N., Schmitt, A.: Developing network effects for digital platforms in two-sided markets – the NfX construction guide. Digital Business **2**(2), 100044 (2022). https://doi.org/10.1016/j.digbus.2022.100044

11. Bergman, R., Abbas, A.E., Jung, S., Werker, C., de Reuver, M.: Business model archetypes for data marketplaces in the automotive industry. Electronic Markets **32**(2), 747–765 (May 2022). https://doi.org/10.1007/s12525-022-00547-x, https://doi.org/10.1007/s12525-022-00547-x
12. Freichel, C., Fieger, J., Winkelmann, A.: Developing a taxonomy for digital platforms – a conceptual approach. In: Proceedings of the Annual Hawaii International Conference on System Sciences. Hawaii International Conference on System Sciences (2021). https://doi.org/10.24251/hicss.2021.701
13. Gordijn, J., Wieringa, R.: E3value User Guide - Designing Your Ecosystem in a Digital World. The Value Engineers, 1st edn. (2021)
14. Koch, M., Krohmer, D., Naab, M., Rost, D., Trapp, M.: A matter of definition: Criteria for digital ecosystems. Digital Business **2**(2), 100027 (2022). https://doi.org/10.1016/j.digbus.2022.100027
15. Koch, M., Polst, S., Naab, M., Bartels, N.A., Storck, S., Trapp, M., Rauch, B., Jeswein, T.: Digitale Ökosysteme in Deutschland. Fraunhofer Publica (2023). https://doi.org/10.24406/publica-1011
16. Kundisch, D., Muntermann, J., Oberländer, A.M., Rau, D., Röglinger, M., Schoormann, T., Szopinski, D.: An update for taxonomy designers. Business &amp Information Systems Engineering **64**(4), 421–439 (Oct 2021). https://doi.org/10.1007/s12599-021-00723-x, https://doi.org/10.1007/s12599-021-00723-x
17. Moore, J.F.: The Death of Competition: Leadership and Strategy in the Age of Business Ecosystems. Wiley Harper Business (1996)
18. Nickerson, R.C., Varshney, U., Muntermann, J.: A method for taxonomy development and its application in information systems. European Journal of Information Systems **22**(3), 336–359 (May 2013). https://doi.org/10.1057/ejis.2012.26
19. Parker, G.G., Van Alstyne, M.W., Choudary, S.P.: Platform revolution: How networked markets are transforming the economy and how to make them work for you. WW Norton & Company (2016)
20. Springer, V., Petrik, D.: Towards a taxonomy of impact factors for digital platform pricing. In: Agile Processes in Software Engineering and Extreme Programming – Workshops, pp. 115–124. Springer International Publishing (2021). https://doi.org/10.1007/978-3-030-88583-0˙11
21. Staub, N., Haki, K., Aier, S., Winter, R.: Taxonomy of digital platforms: A business model perspective. In: Proceedings of the Annual Hawaii International Conference on System Sciences. Hawaii International Conference on System Sciences (2021). https://doi.org/10.24251/hicss.2021.744
22. Täuscher, K., Laudien, S.M.: Understanding platform business models: A mixed methods study of marketplaces. European Management Journal **36**(3), 319–329 (2017). https://doi.org/10.1016/j.emj.2017.06.005
23. Teece, D.J.: Business models, business strategy and innovation. Long Range Planning **43**(2) (2010). https://doi.org/10.1016/j.lrp.2009.07.003
24. van de Ven, M., Abbas, A.E., Kwee, Z., de Reuver, M.: Creating a taxonomy of business models for data marketplaces. In: 34th Bled eConference Digital Support from Crisis to Progressive Change: Conference Proceedings. University of Maribor Press (2021). https://doi.org/10.18690/978-961-286-485-9.23
25. Weking, J., Hein, A., Böhm, M., Krcmar, H.: A hierarchical taxonomy of business model patterns. Electronic Markets **30**(3), 447–468 (Dec 2018). https://doi.org/10.1007/s12525-018-0322-5, https://doi.org/10.1007/s12525-018-0322-5